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Megacity NO_x emissions and lifetimes probed from space

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Megacity emission inventories, based on bottom-up estimates, are still highly uncertain, in particular in developing countries. Satellite observations have been demonstrated to allow regional and global top-down emission estimates of nitrogen oxides (NO_x=NO+NO_2), but require poorly quantified a-priori information on the lifetime of NO_x.

Here we present a new method for the determination of megacity NO_x emissions and lifetimes from satellite measurements. Mean patterns of NO_2 tropospheric columns are analyzed separately for a set of different wind direction sectors. From the combined use of the observed total burden and the downwind evolution of NO_2, mean NO_x photochemical lifetimes and total emissions are derived simultaneously.

Typical daytime lifetimes of about 5 hours are found for several megacities at low and mid-latitudes, corresponding to mean OH concentrations of $5*10^6$ molec/cm^3, whereas for Moscow in wintertime, a lifetime of 16 hours has been derived. The derived emissions are generally in good agreement with bottom-up inventories, but are significantly higher in the case of Riyadh (Saudi Arabia).